

# Stratosphere-troposphere Interactions and Precipitation

- 1) SSWs
- 2) QBO-MJO

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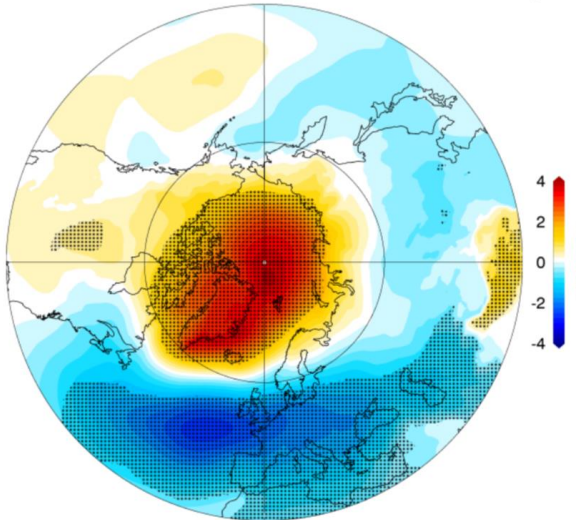


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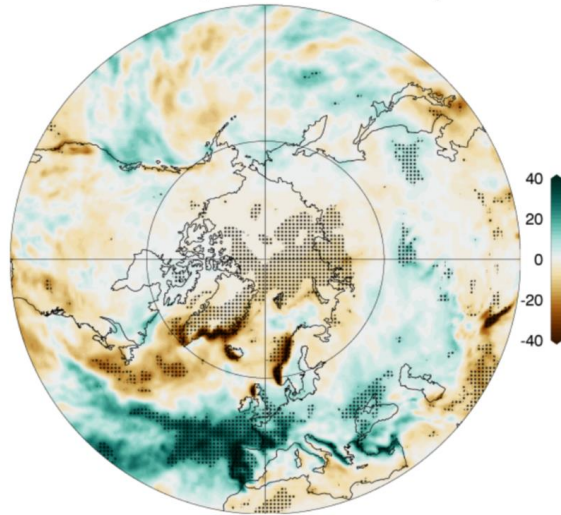


# Sudden Stratospheric Warmings (SSWs)

(a) Mean sea level pressure anomaly



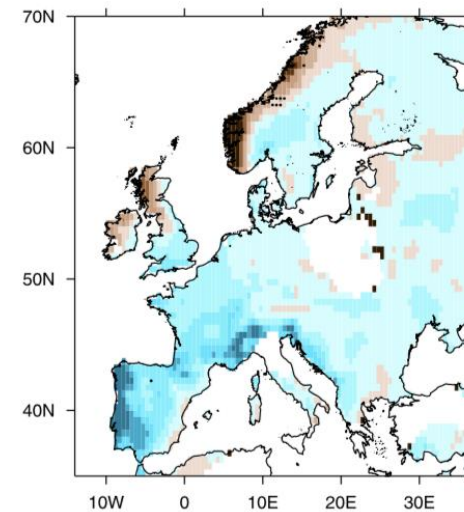
(c) Precipitation anomaly



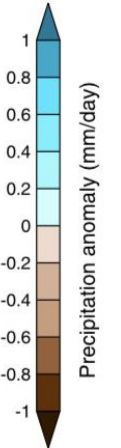
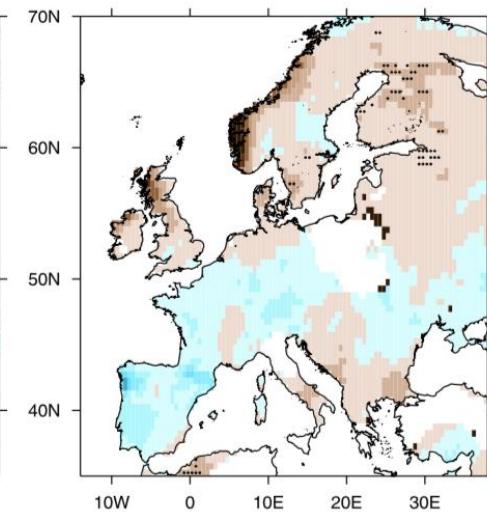
Composite of 60 days following historical SSWs  
(Butler et al. 2017)

*N Europe: Wetter*  
*SW Europe: Drier*

In month after SSW



In second month after SSW



King et al. (2019)

# How to Capture SSW Predictability?

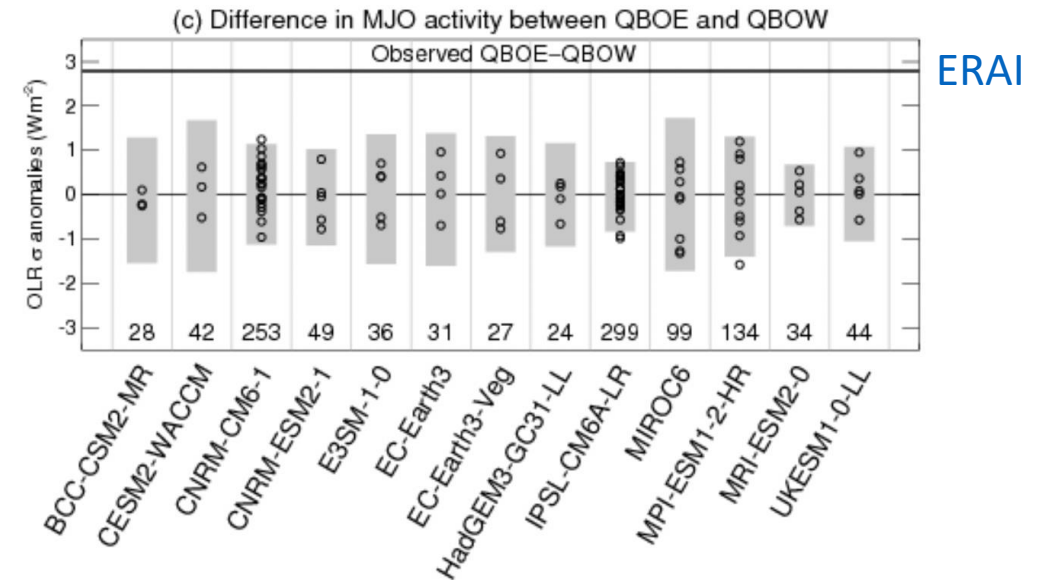
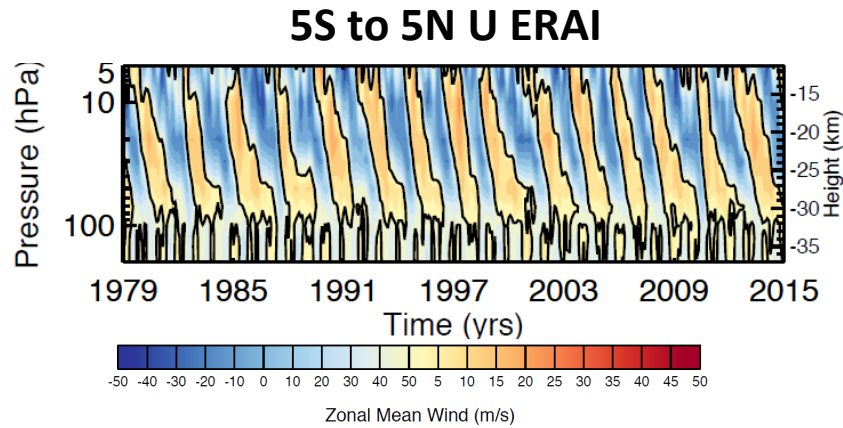
- Include well-resolved stratosphere
- Get the polar vortex climatology right (and coupling)
- Spend time on the Gravity Wave parameterization



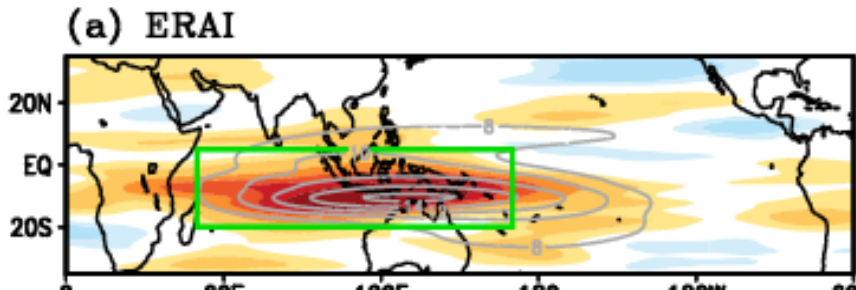


# QBO-MJO

No CMIP6 model reproduces the observed QBO-MJO relationship



**MJO-filtered OLR: QBOE - QBOW**



Gray bars show the 2.5th-97.5th range of anomalies obtained by resampling with replacement from the QBO neutral years with an equivalent sample size to observations.

Kim, Caron, Richter, & Simpson (2020)

# How to Capture QBO-MJO teleconnection?

- Adequate vertical resolution in the stratosphere and troposphere to represent QBO
- GW parameterization
- Improve representation of deep convection (is it deep enough?)

## QBOs in global models:

- **CMIP3:** 0 (2007)
- **CMIP5:** 5 (2012)
- **CMIP6:** 15 (2020)

